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ADAPTIVE GLOBAL FUZZY NEURAL NETWORK CONTROL OF FREE-FLOATING SPACE ROBOT

Abstract

With the development of space technology and the deepening of human exploration of space, space robot system plays an increasingly important role in future space activities. The space robots system can replace astronauts to perform a variety of tasks, including equipment the maintenance, cabin handling, assembly the space station. Therefore, the space robot system has been widely concerned by researchers from all over the world. In the space weightless environment, the space manipulator system has the momentum conservation, moment of momentum or both are conserved in that variety of dynamic constraints form leads to the carrier and the arm of the strong coupling, and has the characteristics of time-varying and non-linear, There is a large number of uncertain factors, so it is impossible to obtain the exact mathematical model of the space robot system. An H-infinity control method based on Takagi-Sugeno global fuzzy Elman neural network is proposed to solve the problem which the dynamic model is uncertain. Fuzzy neural network is a combination of fuzzy logic and artificial neural network, the fuzzy logic of language abstraction, empirical expression and artificial neural network obtain the characteristics of the system approximation together through learning, that composed of a system which is better than a separate fuzzy logic performance or a separate Neural network performance, it has great advantages in dealing with nonlinear, fuzzy and other issues. Takagi-Sugeno model fuzzy and Elman neural networks belong to model-free estimator and nonlinear dynamic system. It is useful to deal with nonlinear, uncertain and other non-directional problems. After combining, this method can approximate nonlinear function by arbitrary precision. Firstly, Takagi-Sugeno global fuzzy Elman neural network is used to modeling the uncertain space robot system, and it is not necessary to transform the dynamic model of the space robot system, then the singularity is not generated, which overcomes the poor system robustness and the poor tracking performance characteristics. The controller adopts H-infinity control theory with the fuzzy neural network effectively. The robustness compensation term is used to attenuate the modeling error and external interference to a predetermined index. Combing controller with Elman neural network is easy deal with the modeling of bounded disturbance and unstructured unmodeled dynamics. The simulation results prove the controller's efficiency.